R E P O R T R E S U M E S

ED 016 392 EM 005 646

CLOSED-CIRCUIT TELEVISION AS A TEACHING AID.

BY- MARTIN, JOHN R.
CASE INST. OF TECH., CLEVELAND, OHIO

REPORT NUMBER RR-948-4 PUB DATE 1 AUG 57
EDRS PRICE MF-$0.25 HC-$0.64 14P.

DESCRIPTORS- *EDUCATIONAL TELEVISION, *CLOSED CIRCUIT TELEVISION, MILITARY TRAINING, *TECHNOLOGY, LECTURE, *EQUIPMENT UTILIZATION, *DEMONSTRATIONS (EDUCATIONAL), EFFECTIVE TEACHING

THE UTILITY OF CLOSED CIRCUIT TELEVISION (CCTV) FOR THE TEACHING OF COMPLEX TECHNOLOGICAL MATERIAL IS EXAMINED. THE AUTHOR FEELS THAT MILITARY, SURGICAL, AND DENTAL TRAINING CAN PARTICULARLY BENEFIT FROM CCTV, AND THAT LECTURE DEMONSTRATIONS ARE MOST EFFECTIVELY PRESENTED VIA CCTV. EQUIPMENT REQUIREMENTS ARE DISCUSSED. (MS)

ED016392

5-100
EMT 3A

EM005646

TWO-WAY CLOSED-CIRCUIT EDUCATIONAL TELEVISION

by John R. Martin

RESEARCH REPORT

NO. 948-4

CASE Institute of Technology
Cleveland 6, Ohio

CLOSED-CIRCUIT TELEVISION AS A TEACHING AID

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

By

John R. Martin

Research Report Number 948-4

Under Grant From
Committee on Utilization of College Resources
Fund for the Advancement of Education

Submitted by:

John R. Martin
Associate Professor
Department of Electrical Engineering

Approved by:

Samuel Seely
Head
Department of Electrical Engineering

Case Institute of Technology
Cleveland, Ohio
1 August 1957

EM 005 646

I. Introduction

During the past several years there has been an increasing interest in the use of closed-circuit television in education. A large number of colleges and secondary schools are now experimenting with its use and comparing its value with conventional teaching methods.

For the most part, these studies have been confined to the use of closed-circuit television as a medium of instruction, and as a possible answer to the problem of maintaining a competent teaching staff for an increasingly large student enrollment. In public or tax supported schools particularly, it is difficult to limit the number of students. Any method which permits a single instructor to reach a large number of students more effectively than by the use of a large lecture room is an attractive possibility. In general, studies have indicated that this application of closed-circuit television has considerable merit in certain areas of instruction, although there are a number of limitations and difficulties in its use.

The most obvious application of educational closed-circuit television, however, seems to have attracted little attention in the past, except in a few limited areas of instruction. This is its use as a teaching aid, whereby a more effective use is made of educational resources already available. Except for dental schools, and to a lesser degree medical schools, most educational applications have limited the use of closed-circuit television as a teaching aid to the simplest and most elementary type of laboratory demonstrations. Yet it is in the teaching of complex technological material that the use of closed-circuit television would seem to be most useful, not only for large numbers of students by either one or two-way operation, but also for individual small classes.

II. Lecture Demonstrations as Teaching Aids

Several decades ago, lecture demonstrations were considered an essential part of practically all instruction in the physical sciences. Elaborate equipment, models, and special lecture room facilities were developed to implement this phase of the instructional process. However, as the number of students increased, effective presentation became increasingly difficult, especially in the demonstration of small equipment.

In advanced courses, the more abstract nature of the subject matter and the greater complexity of the equipment has brought about a marked reduction in the use of lecture demonstrations even for small groups. As a result, the responsibility of relating classroom abstractions to physical reality has been, for the most part, relegated to laboratory courses.

While few would doubt the value of laboratory training, this cannot altogether take the place of carefully prepared lecture demonstrations, both to illustrate the theory and to demonstrate good laboratory techniques. Unfortunately, however, if the equipment must be moved from the laboratory to a class or lecture room, the effort involved in preparing an elaborate instrument setup may seem out of proportion to the value of a demonstration to be used for only a fraction of the class period. If the class or lecture room has a high use factor, the room may not be available for preparation and removal of the demonstration. Frequently the equipment may be too bulky, or too heavy, or too delicate to be moved, or it may be too dangerous for close observations. Any effort to bring the class to the demonstration location is time consuming, and usually only a fraction of the class can have a satisfactory view of the apparatus, especially if it includes a number of small components. In a number of cases, such as the electron microscope, x-ray inspections, and astronomical telescopes, not only must the equipment remain in a fixed location, but observations are possible only by one individual at a time.

Even when laboratory courses are provided as an alternative to classroom demonstrations, it is sometimes necessary to restrict these to a few students because of limitations of space and facilities, particularly if the equipment is both bulky and expensive. In turn, this leads to high instructional costs.

Another aspect of scientific training not usually available to the undergraduate student is contact with research. Although some member of the academic staff, or even the instructor himself, may be conducting experimental research on a subject being discussed in class, it would usually be impossible to move the research equipment to a distant classroom. Unless the research area is unusually large, it would be equally difficult for an entire class to properly observe the

research operation. Moreover, the danger of disturbing delicate or critically adjusted apparatus might make direct group observation undesirable.

Closed-circuit television can provide a solution for all of the above difficulties with a minimum of effort on the part of the instructor. Actually, because of the ability of the camera to enlarge particular portions of the equipment, a student in a remote location can view the experiment even better than he could at the experiment position without television. Depending on the number of viewing screens, almost any number of students can observe a demonstration with equal clarity. It seems to be unexcelled for mass instruction of difficult techniques. Military, surgical, and dental training in particular are especially suited to this method of instruction.

III. Advantages of Radio-Frequency Distribution

Demonstrations using closed-circuit television has usually been confined to transmission over a video-frequency distribution system from a central studio. While this method is well suited for mass instruction involving simple demonstrations of small equipment, it offers no solution for most of the problems of lecture demonstrations previously discussed. Equipment still has to be taken to the studio, set up, torn down and returned to its original location. Equipment whose position must remain fixed outside the studio cannot be shown, and it is unlikely that research or other complex experimental arrangements will be attempted.

By providing a radio-frequency distribution system which permits camera transmission from any location in a building to any other location, the limitations of a centralized studio presentation are overcome, and the other difficulties of lecture demonstrations are solved. Such a distribution system is used in the Electrical Engineering Building at Case Institute of Technology and has been previous described.[1,2] In this installation, there are twenty-seven camera outlets and thirty-eight receiver outlets, distributed so that every laboratory and research room is connected with every class and lecture room in the building by a single coaxial transmission line. Wall plates are provided so that cameras and receivers can easily be connected to the system, in addition to an audio line which also interconnects all rooms. Thus, a camera or

cameras can be placed at any location in the building and the scene viewed by the camera transmitted to any other desired position. Since the transmission is at radio-frequency, a number of independent programs can be transmitted simultaneously, and standard commercial television receivers can be used in the classrooms as well as for monitors.

IV. Example of Use as a Teaching Aid

Use of the system as a teaching aid is best illustrated by describing a typical instructional situation. An instructor located in a conventional type of classroom, (Figure 1), is discussing microwave pulse analysis. The only extraneous equipment in the classroom is a standard television receiver, a microphone, and an amplifier, all of which are connected to a room wall plate. The instructor conducts his class in the usual manner, developing the mathematical background necessary for the analysis. When he is ready to discuss the electrical instrumentation, he informs an assistant in the remote laboratory by means of the classroom microphone and amplifier. The equipment being viewed by the remote camera then appears on the television screen, and the instructor discusses the equipment with the class. He is in complete charge of the classroom situation: he can answer questions, direct repeat demonstrations, show close-up views of particular portions of the equipment or any other variations as required. The assistant in the remote laboratory operates the camera, as shown in Figure 2. He is at all times in direct audio contact with the instructor in case there is any misunderstanding of the action desired. Since the apparatus is in its normal location and is a permanent arrangements, there has been no unusual preparation necessary for the demonstration except the placement of the camera and associated equipment at the experiment position. The camera is plugged into a room wall plate which also distributes sound from the remote classroom. In the example illustrated, it would be impractical to remove the equipment to either a classroom or studio. It would be equally unsatisfactory to move a class to the laboratory where only a few students could observe the demonstration at one time.

Although it is possible for the instructor to lecture from the experiment position rather than from the classroom, experience has shown that the method described is preferable. The instructor has better

Figure 1

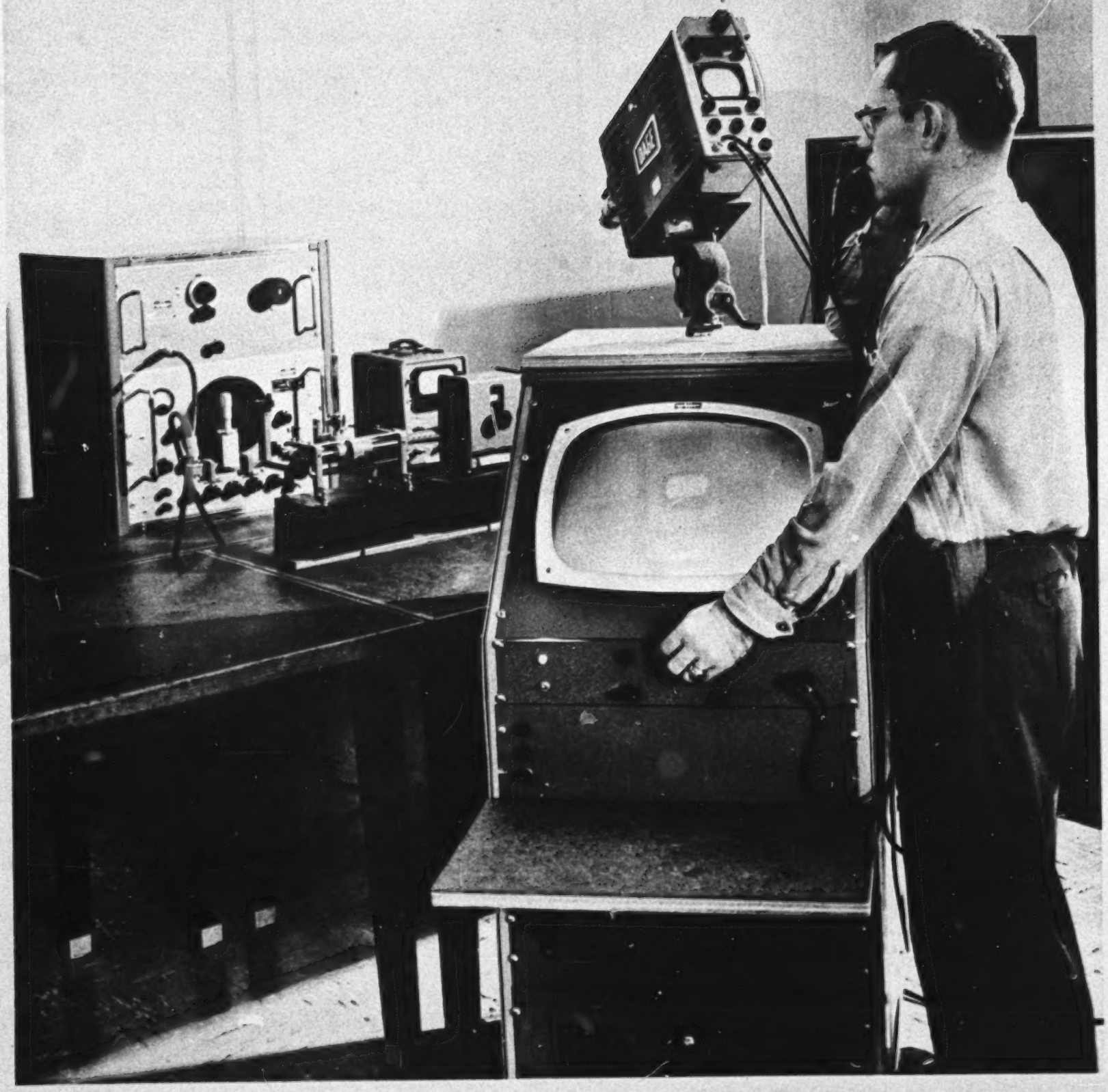

Figure 2

control over the classroom, questions and discussions are more easily handled and equipment requirements are simplified. The instructor is, in effect, the program director, with assistants performing the necessary procedures as desired. It is found helpful if a cue sheet is supplied to the assistants indicating the approximate timing of the demonstration. Aside from this, no special preparation by the instructor is necessary except a pre-check on the operation of the experimental equipment.

Many variations of the presentation are possible. In addition to the class at the instructor position, remote classes in any other room in the building can also observe the demonstration using either one-way or two-way operation. With a modulated-carrier control system[3] it is also possible for the instructor to operate the equipment and control the remote camera from the classroom. If the experiment involves a number of related instrument assemblies in different parts of the building, cameras at these locations will permit the observation of all experiments; either separately or simultaneously, depending on the number of receivers available.

One especially valuable application is pre-laboratory orientation. A large number of students can be briefed on the use of basic laboratory facilities which they will be expected to use during a course as well as on particular laboratory experiments.

V. Equipment Requirements

There may be some question as to whether closed-circuit television equipment can be justified in terms of cost, if its only use is for occasional lecture demonstrations in a limited number of courses. Actually, the basic equipment requirements are quite simple and of reasonable cost. Aside from the television receiver, microphone and audio amplifier at the classroom, the only equipment needed at the experiment position is a loud speaker, a television monitor, lighting facilities and a simple television camera. The only special requirement for this equipment is mobility, to permit rapid changes from one laboratory to another. A portable 17 inch television receiver will be found very satisfactory as a monitor unit. The camera can be an industrial type with self-contained synchronizing generator and channel-

carrier oscillator. An electronic viewfinder on the camera may be convenient, but is not necessary since the monitor will present the same image as that received at the distant classroom. However, a three lens turret is necessary to permit both overall and close up views of the equipment. Lenses of 1, 2, and 3 inch focal lengths are most satisfactory. Large aperture lenses are not necessary, since it is not difficult to provide high illumination levels and a large depth of focus is often desirable. Instead of the usual camera tripod, the monitor, camera, and loud speaker can be combined on a single mobile unit as shown in Figure 2. This is adequate for most types of laboratory demonstrations and requires only a single operator.

If cost is not a serious factor, a much more effective presentation will be obtained with two cameras. Changes in camera position, type of lens, focus and lighting, which are generally necessary with a single camera, may detract considerably from the value of the demonstration. Equipment requirements, however, are considerably more complicated and expensive, and additional operators will be required. In addition to the second camera, facilities for camera switching and controls must be provided, as well as separate video monitors, a synchronizing generator and video-modulated carrier oscillator. These are also the components necessary when closed-circuit television is used as a teaching medium, and the same equipment can be used for both purposes if a highly mobile assembly is used.

A representative two-camera arrangements is shown in Figure 3. All equipment is mounted in matching consoles which permits their use separately or in a single unified assembly, as determined by the operating requirements. Consoles are mounted on heavy, locking rubber casters for mobility, and dimensioned to permit the use of standard 19 inch equipment panels. Each panel is a complete unit with plug-in connections to other similarly mounted equipment and is designed so that changes or variations in equipment facilities can be made easily and inexpensively. Consoles similar to those shown can be obtained commercially or can be fabricated, if construction facilities are available. Most television control equipment is supplied on standard width panels and blank panels for special assemblies are standard supply items.

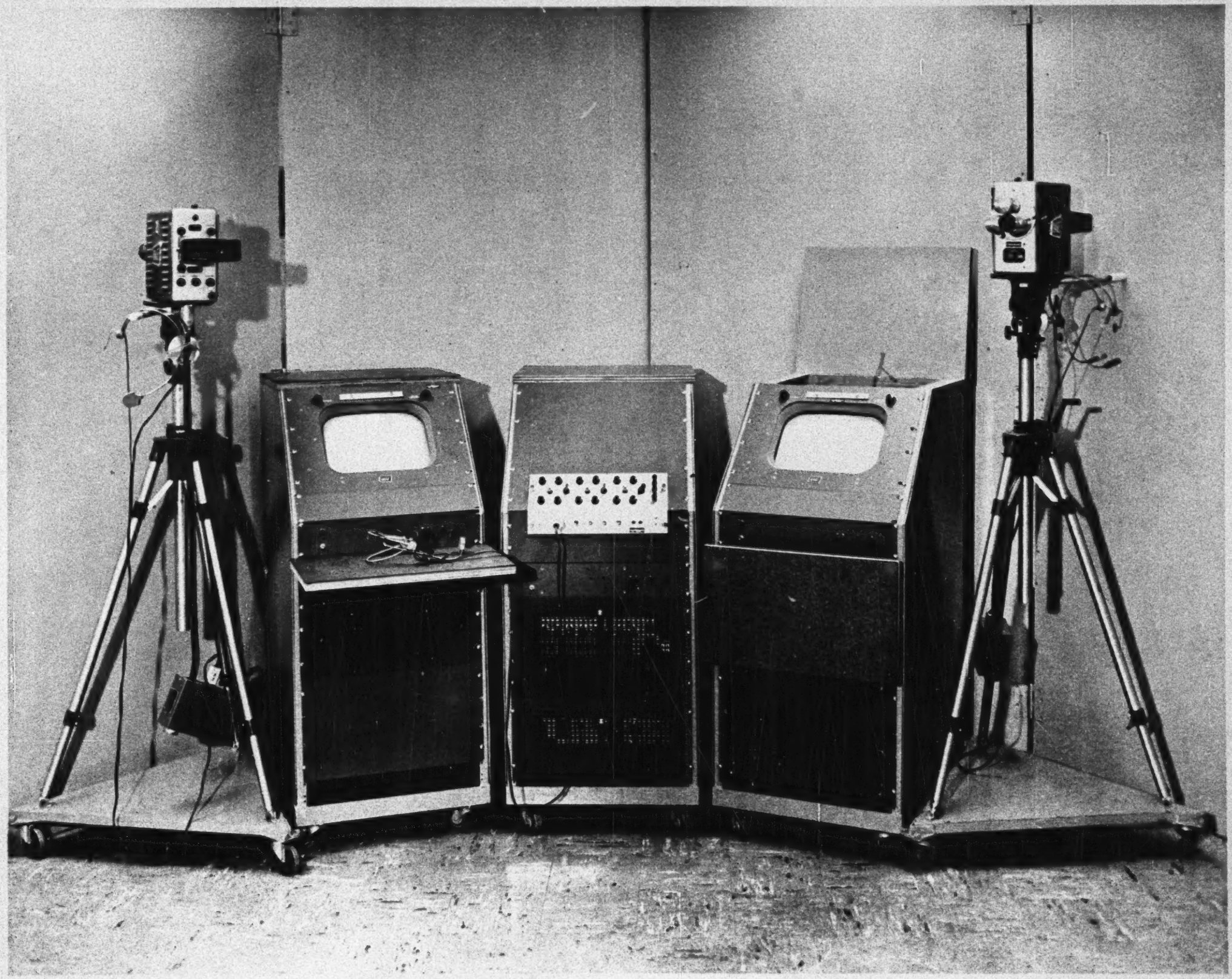

Figure 3

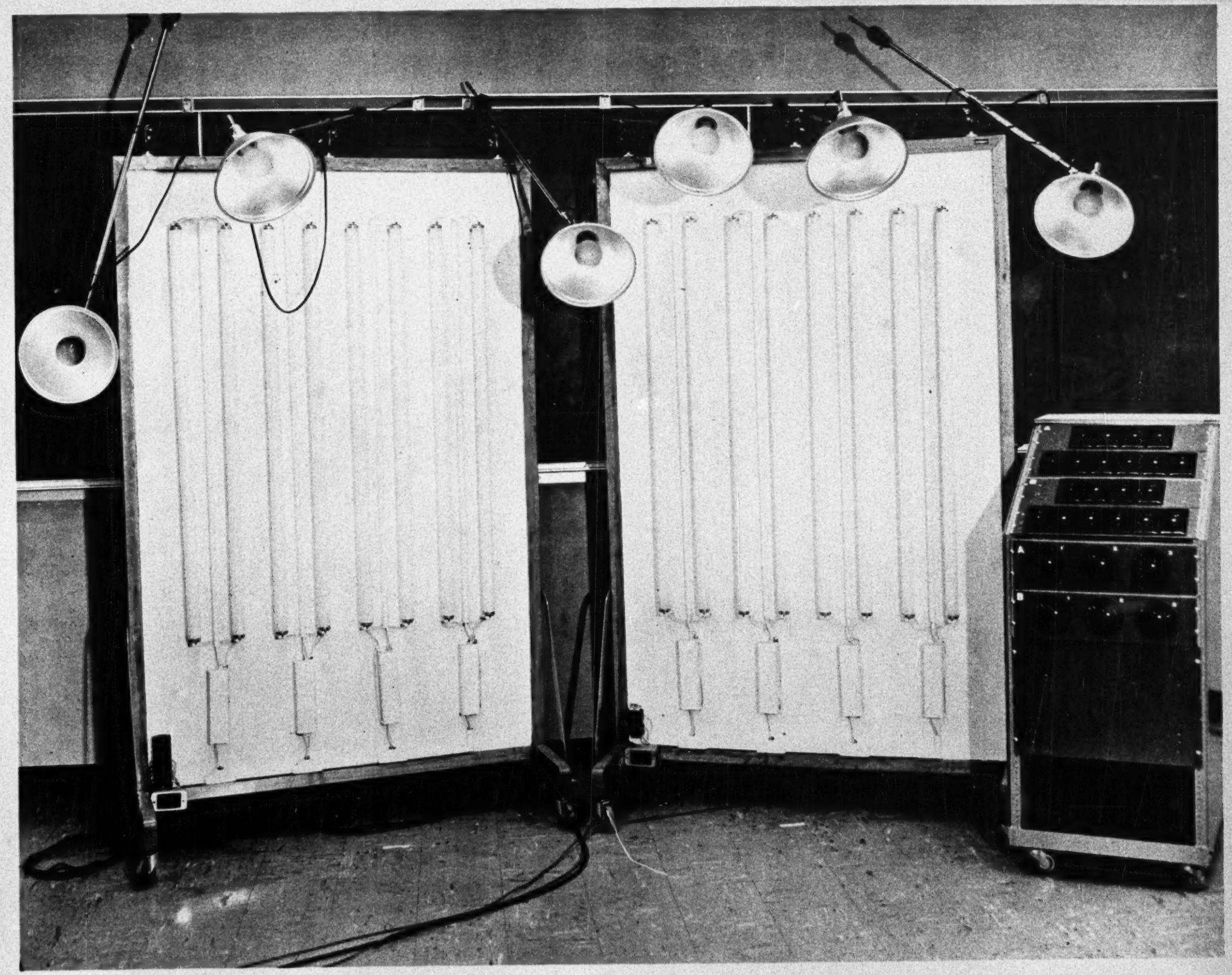

Figure 4

Lighting requirements for televised experiments or demonstrations are considerably different from those required for other types of programs. Flat lighting is usually desirable, since high intensity spots tend to produce deep shadows as well as strong reflections from meter faces or other reflecting surfaces. Much equipment has its working surface in a vertical plane and overhead room lighting is usually inadequate.

The lighting units shown in Figure 4 were designed to provide high intensity front lighting which is practically shadowless. Four rapid-start fluorescent tubes, six feet long, are mounted on a vertical panel which can be sheeled into any desired position. Three light units with universal positioning are mounted on the top of the light board to provide extra overhead or spot lighting if required. The intensity of these units is controlled by variacs mounted on a switching console similar in design to the instrument consoles.

VI. Experience in Use

The systems described have been in use at Case Institute of Technology during the past year as a part of the studies in the use of educational closed-circuit television under a grant from the Committee on the Utilization of College Resources of the Fund for the Advancement of Education. The facilities have been used for demonstrations of analog and digital computers, astronomical observations, laboratory instruction in electrical measurement courses and demonstrations of various types of graphical instruments and presentations. Except for astronomical observations, its use has been confined to the electrical engineering building since this is the only building presently equipped with a radio-frequency distribution system. Recently constructed buildings and those now under construction have provisions for the addition of such distribution systems. Plans are also being formulated for inter-building operation. Thus, it will be possible to observe the operation of equipment which may be located on any part of the campus at any other point of the campus. The chief limitation to the effective use of closed-circuit television as a teaching aid may be the lack of imagination on the part of the instructional staff in using this educational tool, rather than the inadequacy of reasonably priced equipment.

REFERENCES

1. "Developments in Closed Circuit Television", M.H. Kraus, Electrical Engineering, November 1955, Volume 74, Number 11, pages 974-979.

2. "Two-Way Educational Closed Circuit Television", J.R. Martin, Electrical Engineering, October 1957, Volume 76, Number 10, pages 921-923.

3. "Remote Control Carrier Systems in Two-Way Closed-Circuit Educational Television", J.R. Martin, R.N. Vandeland and B.W. Warnick, Research Report No. 948-2, February 1957.